

WHAT IS CLAIMED IS:

1. A body composition estimation method comprising calculating a parameter of a bioelectrical impedance in a body  
5 part to be measured, from a parameter value of an electric current to be applied to a living body and a parameter value of a measured voltage, wherein by use of a parameter representing an intracellular/extracellular fluid ratio which is included in a parameter value of a bioelectrical impedance  
10 measured at a given frequency, the parameter value of the measured bioelectrical impedance is corrected and a body composition is estimated based on the corrected parameter value.

15 2. The method of claim 1, wherein the given frequency is the frequency of the electric current applied to the living body for estimation of the body composition.

20 3. The method of claim 1, wherein the given frequency is a frequency different from the frequency of the electric current applied to the living body for estimation of the body composition.

25 4. The method of claim 1, wherein the parameter to be corrected of the bioelectrical impedance is any of the absolute value of the bioelectrical impedance, a bioelectrical impedance vector value or the resistance component value of the bioelectrical impedance vector.

5. The method of claim 2, wherein when the parameter associated with the bioelectrical impedance which is corrected by the parameter associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is  $P'$ ,  $P'$  is calculated in accordance with the following correction expression:

$$P' = f(P, \alpha) = K \cdot P^A \cdot \alpha^B + C$$

wherein  $f(P, \alpha)$  is a correction function represented by parameters  $P$  and  $\alpha$ ,  $P'$  is the corrected parameter associated with the bioelectrical impedance,  $P$  is the measured parameter associated with the bioelectrical impedance,  $\alpha$  is the parameter associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio, and  $A$ ,  $B$ ,  $C$  and  $K$  are constants.

6. The method of claim 5, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of a phase difference  $\phi$  between the waveform of the alternating current applied to the living body and the waveform of the measured voltage at the time of measurement of the bioelectrical impedance.

$$\alpha = 1/\phi$$

7. The method of claim 5, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as

follows by use of a phase difference  $\phi$  between the waveform of the alternating current applied to the living body and the waveform of the measured voltage at the time of measurement of the bioelectrical impedance.

5  $\alpha = 1/\tan(\phi)$

8. The method of claim 5, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of a parameter included in the parameter associated with the bioelectrical impedance to be corrected or a parameter associated with a bioelectrical impedance which is measured at other frequency.

$$\alpha = R/X$$

15 wherein R is the resistance component of the bioelectrical impedance, and X is the reactance component of the bioelectrical impedance.

9. The method of claim 5, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of the absolute value of the bioelectrical impedance or the resistance component value of the bioelectrical impedance which is a parameter associated with a bioelectrical impedance at higher and lower frequencies than a measuring frequency for the parameter associated with the bioelectrical impedance to be corrected or either one of which is the parameter associated with the bioelectrical impedance

to be corrected.

$$\alpha = P_{\text{high}}/P_{\text{low}}$$

wherein  $P_{\text{high}}$  is a parameter associated with a bioelectrical impedance at a higher frequency, and  $P_{\text{low}}$  is a parameter  
5 associated with a bioelectrical impedance at a lower frequency.

10. The method of claim 5, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as  
10 follows by use of the absolute value of the bioelectrical impedance or the resistance component value of the bioelectrical impedance which is a parameter associated with a bioelectrical impedance at higher and lower frequencies than a measuring frequency for the parameter associated with the  
15 bioelectrical impedance to be corrected or either one of which is the parameter associated with the bioelectrical impedance to be corrected.

$$\alpha = P_{\text{low}}/(P_{\text{low}}-P_{\text{high}})$$

wherein  $P_{\text{high}}$  is a parameter associated with a bioelectrical  
20 impedance at a higher frequency, and  $P_{\text{low}}$  is a parameter associated with a bioelectrical impedance at a lower frequency.

11. The method of claim 5, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents  
25 the intracellular/extracellular fluid ratio is expressed as follows by use of the absolute value of the bioelectrical impedance or the resistance component value of the bioelectrical impedance which is a parameter associated with

a bioelectrical impedance at higher and lower frequencies than a measuring frequency for the parameter associated with the bioelectrical impedance to be corrected or either one of which is the parameter associated with the bioelectrical impedance to be corrected.

$$\alpha = P_{\text{high}} / (P_{\text{low}} - P_{\text{high}})$$

wherein  $P_{\text{high}}$  is a parameter associated with a bioelectrical impedance at a higher frequency, and  $P_{\text{low}}$  is a parameter associated with a bioelectrical impedance at a lower frequency.

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12. The method of claim 5, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by a bioelectrical impedance value  $R_0$  at a frequency of 0 Hz and a bioelectrical impedance value  $R_{\text{inf}}$  at an infinite frequency which are determined from bioelectrical impedance values measured at a number of frequencies.

$$\alpha = R_{\text{inf}} / R_0$$

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13. The method of claim 5, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of an intracellular fluid resistance value  $R_i$  and an extracellular fluid resistance value  $R_e$  which are calculated based on a bioelectrical impedance value  $R_0$  at a frequency of 0 Hz and a bioelectrical impedance value  $R_{\text{inf}}$  at an infinite frequency which are determined from bioelectrical impedance values measured at a number of frequencies.

$$\alpha = R_i/R_e$$

14. A body composition measuring apparatus comprising:  
an electric current applying unit,

- 5 a voltage measuring unit,  
a bioelectrical impedance computing unit,  
a correcting unit, and  
a body composition computing unit,

wherein

- 10 the electric current applying unit applies an electric current  
to a living body,  
the voltage measuring unit measures a voltage,  
the bioelectrical impedance computing unit computes a parameter  
associated with a bioelectrical impedance of a measured body  
15 part from the applied electric current and the measured voltage,  
the correcting unit corrects the parameter value associated  
with the measured bioelectrical impedance by use of a parameter  
representing an intracellular/extracellular fluid ratio which  
is included in the parameter value of the bioelectrical  
20 impedance measured at a given frequency, and  
the body composition computing unit computes an index  
associated with a body composition based on the corrected  
parameter value associated with the bioelectrical impedance.

- 25 15. The apparatus of claim 14, wherein the given  
frequency is the frequency of the electric current applied to  
the living body for estimation of the body composition.

16. The apparatus of claim 14, wherein the given frequency is a frequency different from the frequency of the electric current applied to the living body for estimation of the body composition.

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17. The apparatus of claim 14, wherein the parameter of the bioelectrical impedance which is corrected by the correcting unit is any of the absolute value of the bioelectrical impedance, a bioelectrical impedance vector  
10 value or the resistance component value of the bioelectrical impedance vector.

18. The apparatus of claim 14, wherein when the parameter associated with the bioelectrical impedance which has been  
15 corrected by the parameter associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is  $P'$ , the correction of the parameter associated with the bioelectrical impedance in the correcting unit is made in accordance with the following correction expression:

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$$P' = f(P, \alpha) = K \cdot P^A \cdot \alpha^B + C$$

wherein  $f(P, \alpha)$  is a correction function represented by parameters  $P$  and  $\alpha$ ,  $P'$  is the corrected parameter associated with the bioelectrical impedance,  $P$  is the measured parameter associated with the bioelectrical impedance,  $\alpha$  is the parameter  
25 associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio, and  $A$ ,  $B$ ,  $C$  and  $K$  are constants.

19. The apparatus of claim 18, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of a phase difference  $\phi$  between the waveform of the alternating current applied from the electric current applying means to the living body and the waveform of the voltage measured by the voltage measuring means at the time of measurement of the bioelectrical impedance.

$$\alpha = 1/\phi$$

20. The apparatus of claim 18, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of a phase difference  $\phi$  between the waveform of the alternating current applied from the electric current applying means to the living body and the waveform of the voltage measured by the voltage measuring means at the time of measurement of the bioelectrical impedance.

$$\alpha = 1/\tan(\phi)$$

21. The apparatus of claim 18, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of a parameter included in the parameter associated with the bioelectrical impedance to be corrected or a parameter associated with a bioelectrical impedance which is measured at other frequency.

$$\alpha = R/X$$



wherein R is the resistance component of the bioelectrical impedance, and X is the reactance component of the bioelectrical impedance.

5           22. The apparatus of claim 18, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of the absolute value of the bioelectrical impedance or the resistance component value of the  
10 bioelectrical impedance which is a parameter associated with a bioelectrical impedance at higher and lower frequencies than a measuring frequency for the parameter associated with the bioelectrical impedance to be corrected or either one of which is the parameter associated with the bioelectrical impedance  
15 to be corrected.

$$\alpha = P_{\text{high}}/P_{\text{low}}$$

wherein  $P_{\text{high}}$  is a parameter associated with a bioelectrical impedance at a higher frequency, and  $P_{\text{low}}$  is a parameter associated with a bioelectrical impedance at a lower frequency.

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          23. The apparatus of claim 18, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of the absolute value of the bioelectrical  
25 impedance or the resistance component value of the bioelectrical impedance which is a parameter associated with a bioelectrical impedance at higher and lower frequencies than a measuring frequency for the parameter associated with the

bioelectrical impedance to be corrected or either one of which is the parameter associated with the bioelectrical impedance to be corrected.

$$\alpha = P_{\text{low}} / (P_{\text{low}} - P_{\text{high}})$$

- 5 wherein  $P_{\text{high}}$  is a parameter associated with a bioelectrical impedance at a higher frequency, and  $P_{\text{low}}$  is a parameter associated with a bioelectrical impedance at a lower frequency.

24. The apparatus of claim 18, wherein the parameter  $\alpha$   
10 associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of the absolute value of the bioelectrical impedance or the resistance component value of the bioelectrical impedance which is a parameter associated with  
15 a bioelectrical impedance at higher and lower frequencies than a measuring frequency for the parameter associated with the bioelectrical impedance to be corrected or either one of which is the parameter associated with the bioelectrical impedance to be corrected.

20  $\alpha = P_{\text{high}} / (P_{\text{low}} - P_{\text{high}})$

wherein  $P_{\text{high}}$  is a parameter associated with a bioelectrical impedance at a higher frequency, and  $P_{\text{low}}$  is a parameter associated with a bioelectrical impedance at a lower frequency.

25 25. The apparatus of claim 18, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by a bioelectrical impedance value  $R_0$  at a frequency

of 0 Hz and a bioelectrical impedance value  $R_{inf}$  at an infinite frequency which are determined from bioelectrical impedance values measured at a number of frequencies.

$$\alpha = R_{inf}/R_0$$

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26. The apparatus of claim 18, wherein the parameter  $\alpha$  associated with the bioelectrical impedance which represents the intracellular/extracellular fluid ratio is expressed as follows by use of an intracellular fluid resistance value  $R_i$  and an extracellular fluid resistance value  $R_e$  which are calculated based on a bioelectrical impedance value  $R_0$  at a frequency of 0 Hz and a bioelectrical impedance value  $R_{inf}$  at an infinite frequency which are determined from bioelectrical impedance values measured at a number of frequencies.

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$$15 \quad \alpha = R_i/R_e$$